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# SPRAYING WITH LETHAL OIL TO CONTROL THE MOUNTAIN PINE BEETLE IN LODGEPOLE PINE

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# SPRAYING WITH LETHAL OIL TO CONTROL THE MOUNTAIN PINE BEETLE IN LODGEPOLE PINE

## Introduction

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For a number of years the personnel of the California Station of the Division of Forest Insects have experimented with lethal oils in an effort to control the western pine beetle in western yellow pine. The method consisted of mixing or dissolving in a penetrating oil a material lethal to the insects and spraying it upon the infested tree. The oil carries the lethal material through the bark until it is in contact with the infesting brood. Varying degrees of success were obtained by this method even with the thick-barked ponderosa pine. In the thin-barked mountain pine beetle-infested lodgepole pine it was believed that even better success might be secured despite its growth in a region of lower maximum temperatures, so the California Station was requested to allow the more promising materials to be tested by the Coeur d'Alene Station personnel.

## Previous tests

A preliminary test was made with one oil on the Beaverhead Forest in 1934. Sufficient control was secured to justify continuation of the experiment. In 1935 the experiments were continued in an area near Antelope Flat on the Targhee Forest which was suffering severe losses from an aggressive mountain pine beetle infestation in lodgepole pine. Thirty-three trees treated with three different oils gave fairly

good control and a chance to compare the effectiveness of the oils. A few trees were also treated in the fall of the year to determine the length of time during which control can be secured. The results of these fall treatments are given in this report.

The trees sprayed in all experiments were only those which had been attacked completely around the bole. Trees with a green side or a "pitched-out" portion were not selected.

A Smith-Banner hand spray pump of four gallons capacity was used for applying the oils.

To facilitate dissolving the naphthalene used in some of the experiments in 1936 the oils were heated to a temperature of about 90°F.

The liquid was applied in a solid stream until the bark surface was well saturated. Records were kept of the temperature and humidity at various times during the day in order to note any correlation between these factors and the degree of control secured.

In planning the examination of the trees treated in late 1935 and in 1936 counts were to be made of all insect stages and their work on the four sides of the tree both within the sprayed portion and immediately above it. Due to the large amount of work this entailed, it was later found necessary to reduce both the number of sides examined and the number of examinations on the tree, still securing, however, what was considered a representative sample of the number of trees treated by each of the three formulae tried. The examinations were one-quarter of a square foot and made by carefully removing

the bark with a knife, revealing the insect work beneath for counting and recording.

## SPRAYING WITH LETHAL OIL TO CONTROL THE MOUNTAIN PINE BEETLE IN LODGEPOLE PINE TREATED IN 1935 - EXAMINED IN 1936

In October of 1935, near Antelope Flat on the Targhee National Forest, eight lodgepole pine which had been attacked that summer were sprayed with lethal oils to determine if treatment that late in the season would destroy the infesting brood. Three oils were used: Standard Oil Formula 24241-2 on three trees, Standard Oil Formula 21046-2 on two trees, and Reilly's Transparent Penetrating Creosote on three trees. Treatment was only to a maximum of eight feet, as that was deemed sufficient for the purpose of the experiment.

When an extensive examination was made of these trees on June 12th of 1936, very little control was apparent, but the intensive examination on July 16th and 17th showed high mortality. It is evident that some unknown factor, but one thought to be associated with higher temperature or advance in development of the brood, became effective during this interval. The data for the second examination is given in table 1. In order to readily compare the data from this examination with the results obtained in 1935 with the same spray materials, data from table 2 of the preceding year's report on this project have been included.

Table I

DATA FROM TREES SPRAYED WITH REILLY'S CREOSOTE - ASHTON, IDAHO
1935

| Trees 1-5 Sprayed May 29, 1935 | | | Trees 6-12 Sprayed June 23, 1935 | | | Trees 35-1 to 3 Sprayed Oct. 10, 1935 (1) | | |
|---|---|---|---|---|---|---|---|---|
| Attacks per sq.ft. | Emergence per sq. ft. | % emergence is of attacks (2) | Attacks per sq.ft. | Emergence per sq. ft. | % emergence is of attacks (2) | Attacks per sq. ft. | Emergence per sq. ft. | % emergence is of attacks (2) |
| **Data for Basal Section** | | | | | | | | |
| 14.7 | 5.0 | 17.0 | 12.7 | 2.6 | 10.2 | 15.7 | 4.5 | 13.8 |
| **Data for 5' Section** | | | | | | | | |
| 11.6 | 4.3 | 37.1 | 11.4 | 5.8 | 25.4 | 11.7 | .3 | 1.8 |

(1) Attacked in 1935 - trees 1-12 were attacked in 1934.

(2) On basis of two insects for each attack.

Inspection of the preceding table indicates that the best control was secured in the trees sprayed in October of 1935. One striking difference shown by the data from these trees treated late in the season is the greater survival of the brood at the base than at five feet above the ground, a general tendency in all treatments examined in 1936. The data from so few trees is possibly insufficient to serve as a basis for a definite conclusion, but the indications are that good control is secured by spraying trees with this oil even late in the season.

In order that it may be clearly seen that the oil is responsible for much of the mortality, in table 2 data from the sprayed trees are compared with that of untreated trees examined at the same time.

Table II

COMPARISON OF THE MOUNTAIN PINE BEETLE BROOD
IN CREOSOTE-SPRAYED LODGEPOLE PINE AND
IN UNTREATED TREES--ASHTON, IDAHO-1936

Data for 3 Treated and 17 Untreated Trees

| | Brood per Square Foot at | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Base | | | 5' | | | 12' | | |
| | Attacks per sq. ft. | Emergence per sq. ft. | % Emergence is of attacks (1) | Attacks per sq. ft. | Emergence per sq. ft. | % Emergence is of attacks (1) | Attacks per sq. ft. | Emergence per sq. ft. | % Emergence is of attacks (1) |
| Creosote-treated trees | 15.7 | 4.5 | 13.8 | 11.7 | .3 | 1.8 | 5.0 | 3.7 | 36.7 |
| Untreated trees | 17.6 | 21.0 | 59.7 | 12.5 | 10.9 | 43.4 | 8.5 | 5.8 | 33.8 |

(1) On basis of two insects for each attack.

Inspection of the preceding table shows a close similarity in the percent of brood emerging compared with the number attacking for both the treated and check trees at twelve feet above the ground. The sprayed portion showed very little emergence either compared with attacks or in the actual number per square foot. The larger number of attacks for treated trees is due to their larger diameter. It has been found to be a general rule that the larger the tree diameter the greater the amount of insect work and brood.

The least mortality on the sprayed trees occurred on the north side, indicating that exposure to sunlight may be an important factor in securing effective action of the oils.

The chief thing to be learned from this experiment is that fall control may be feasible with certain oils. In certain regions fall control could be done much more economically than spring control.

## TREATMENT WITH STANDARD OIL FORMULA 21046-R

Treatment with this oil in 1935 was only slightly less effective than with the creosote. The data from the two trees sprayed in October with this formula indicate even better control than was obtained with the creosote the preceding year. In table 3 may be seen the data from table 7 of the previously mentioned report* together with data from the trees examined in 1936.

* Control of the Mountain PineBeetle in Lodgepole Pine by Lethal Oils-1935. By A. L. Gibson

Table III

COMPARISON OF BROOD STATUS OF THE MOUNTAIN PINE BEETLE IN LODGEPOLE PINE TREATED WITH STANDARD OIL FORMULA 21046-R AND IN UNTREATED TREES IN 1935 AND 1936 ASHTON, IDAHO

| | Data for Basal Section | | | Data for 5' Section | | |
|---|---|---|---|---|---|---|
| | Attacks per sq. ft. | Emergence per sq. ft. | % Emergence is of attacks (1) | Attacks per sq. ft. | Emergence per sq. ft. | % Emergence is of attacks (1) |
| | | | 1935 Data | | | |
| Ten trees treated with formula 21046-R | 14.0 | 4.4 | 15.7 | 11.1 | 5.8 | 26.1 |
| Four untreated trees | 16.8 | 24.0 | 71.4 | 13.8 | 42.0 | 152.2 |
| | | | 1936 Data | | | |
| Two trees treated with formula 21046-R | 14.0 | 1.5 | 5.4 | 11.5 | -- | -- |
| Seventeen untreated trees | 17.6 | 21.0 | 59.7 | 12.5 | 10.9 | 43.4 |

(1) On basis of two insects for each attack.

Although the data from two trees is insufficient to be considered representative of conditions, it does indicate the effectiveness of this spray even when applied late in the season.

At the base of the two treated trees only two of the four sides examined contained living brood, the north and west, with the north showing twice the number to be found on the west. Again the indications are strong that the effectiveness of the oil is increased by solar heat.

## TREATMENT WITH STANDARD OIL FORMULA 24241-R

In the experiments conducted in 1935 with this oil it was found to be the least effective of the three. The same conclusion may be drawn after a study of the data from the three trees sprayed with this oil in October of 1935 and examined the following year. Treated trees are compared with untreated trees in table 4. Data from table 9 of the preceding year's report are incorporated in this table together with the data for 1936.

Table IV

COMPARISON OF BROOD STATUS OF THE MOUNTAIN PINE BEETLE IN LODGEPOLE PINE TREATED WITH STANDARD OIL FORMULA 24241-R AND IN UNTREATED TREES IN 1935-1936 ASHTON, IDAHO

| | Data for Basal Section | | | Data for 5' Section | | |
|---|---|---|---|---|---|---|
| | Attacks per sq. ft. | Emergence per sq. ft. | % Emergence is of attacks (1) | Attacks per sq. ft. | Emergence per sq. ft. | % Emergence is of attacks (1) |
| | | | 1935 Data | | | |
| Eleven trees treated with Formula 24241-R | 14.4 | 9.0 | 31.3 | 13.2 | 7.0 | 26.5 |
| Four untreated trees | 16.8 | 24.0 | 71.4 | 13.8 | 42.0 | 152.2 |
| | | | 1936 Data | | | |
| Three trees treated with formula 24241-R | 16.3 | 4.7 | 14.3 | 13.7 | 1.7 | 6.1 |
| Seventeen untreated trees | 17.6 | 21.0 | 59.7 | 12.5 | 10.9 | 43.4 |

(1) On basis of two insects for each attack.

From the data shown in the preceding table we may again note that the fall spraying seems to have caused a higher mortality than the same treatment in the early summer. Also the north side of the tree showed the highest survival at the base, but at five feet both the west and east sides contained heavier broods than the north side.

The most valuable conclusion that may be drawn from the results of spraying these trees in October 1935 is that fall as well as spring control seems possible with this method. More economical control is possible by a method which can be used during both seasons.

## EXPERIMENTS CONDUCTED IN 1936

More experiments with lethal oils were conducted in 1936. The objective remained the same--to find an oil that when sprayed upon the infested trees would destroy the brood of the mountain pine beetle. The oils used were mixed in the field (see Plate I, Fig. 1) using ingredients which had given the greatest degree of success when used by the California Forest Insect Field Station in experiments to control the western pine beetle in ponderosa pine.

The trees sprayed with the mixture of 75 percent light and 25 percent heavy stove oil, into which 3/4 pound naphthalene had been dissolved to each gallon of mixture, gave good control of the mountain pine beetle brood. These trees were treated to a height of at least 10 feet from the ground (see Plate I, Fig. 1). A general comparison of data from trees treated with this mixture and similar data from untreated trees is given in the succeeding table.

Table V

COMPARISON OF BROOD STATUS OF THE MOUNTAIN PINE BEETLE IN LODGEPOLE PINE TREATED WITH 75% LIGHT, 25% HEAVY STOVE OIL IN MIXTURE WITH 3/4 LB. NAPHTHALENE PER GALLON OF MIXTURE - ASHTON, IDAHO - 1936

| | Data for Basal Section | | | Data for 5' Section | | | Data for 8' Section | | | Data for 12' Section | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Attacks per sq. ft. | Emergence per sq. ft | % Emergence is of (1) attacks | Attacks per sq. ft. | Emergence per sq.ft. | % Emergence is of (1) attacks | Attacks per sq. ft. | Emergence per sq.ft. | % Emergence is of (1) attacks | Attacks per sq. ft. | Emergence per sq.ft. | % Emergence is of (1) attacks |
| Data from 32 treated trees | 18.1 | 2.85 | 7.9 | 16.2 | .90 | 2.8 | 16.1 | 1.3 | 4.0 | 14.5 | 26.3 | 90.5 |
| 17 untreated trees | 17.6 | 21.0 | 59.7 | 12.5 | 10.9 | 43.4 | 11.4 | 9.5 | 41.7 | 8.5 | 5.8 | 33.8 |

(1) On basis that two insects are required for each attack.

On a previous page an explanation has been given of the reason for the differences in insect work--the variation in diameters. The average diameter of the trees treated with this formula was 15.7 inches as compared with 13.8 inches for the untreated trees. With larger broods in larger diameter trees we are therefore justified in claiming even better control than the comparison in table 4 indicates.

From the preceding data it may be seen that brood in the treated portion of the trees suffered very high mortality. Of the treated portion the base showed the greatest survival, probably as a result of thicker bark offering more protection to the brood. The influence of bark thickness on brood survival for both the treated and untreated trees for this formula is given in table 6.

Table VI

BROOD SURVIVAL VS. BARK THICKNESS IN MOUNTAIN PINE BEETLE-INFESTED LODGEPOLE PINE SPRAYED WITH LETHAL OIL-75% HEAVY, 25% LIGHT STOVE OILS TO WHICH 3/4 LB. NAPHTHALENE PER GALLON WAS ADDED AND IN UNTREATED TREES
1936 - ASHTON, IDAHO

| Bark thickness | | .05 | .1 | .15 | .2 | .25 | .3 | .35 | .4 | .45 | .5 | .55 | .6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No. of samples | Treated | -- | 44 | 53 | 46 | 30 | 11 | 5 | 1 | 1 | 2 | -- | 1 |
| | Untreated | 11 | 115 | 57 | 54 | 30 | 4 | 1 | -- | -- | -- | -- | -- |
| No. of brood | Treated | -- | 3 | 19 | 18 | 23 | 7 | 2 | -- | 2 | 5 | -- | -- |
| | Untreated | 13 | 191 | 158 | 194 | 236 | 14 | 6 | -- | -- | -- | -- | -- |
| Brood per sq.ft. | Treated | -- | .27 | 1.43 | 1.57 | 3.07 | 2.55 | 1.60 | -- | 8.00 | 10.00 | -- | -- |
| | Untreated | 4.73 | 6.64 | 11.09 | 12.52 | 31.47 | 14.00 | 24.00 | -- | -- | -- | -- | -- |

The preceding tabulation indicates quite clearly that survival is greatest under thicker bark in both treated and untreated trees. The variations in the trend of the data above .25 inch bark thickness are believed to be due to too few samples. In treated trees the survival under bark .1 inch thick is only 17 percent of what it is under bark .2 inch thick, and 9 percent of that under .25 inch of bark. In untreated trees brood under .1 inch bark is 53 percent of that under .2 inch, and 21 percent of the amount under .25 inch of bark protection. The higher proportionate brood mortality under .1 inch bark of treated trees compared with that of untreated trees indicates not only the effectiveness of the oil, but its greater effectiveness where the bark is thin than under thick bark.

In this experiment solar heat does not seem to have increased the effectiveness of the oil, judging from the data showing percent of brood present on the four sides of both treated and untreated trees whichare given in table 7.

Table VII

PERCENT OF TOTAL BROOD PRESENT ON EACH SIDE OF MOUNTAIN PINE BEETLE-INFESTED LODGEPOLE PINE. DATA ARE FOR BASAL, 5-FOOT, AND 8-FOOT SAMPLES. ASHTON, IDAHO - 1936

Data from trees treated with 75 percent heavy and 25 light stove oil in which 3/4 pound naphthalene per gallon of oil has been dissolved.

| Side of Tree | | N | E | S | W |
|---|---|---|---|---|---|
| Percent of total brood | Treated | 40.8 | 16.0 | 9.8 | 33.0 |
| | Untreated | 40.9 | 16.1 | 21.0 | 21.8 |

The greater mortality on the south side, which could be logically considered as indicating the influence of solar heat, is in contrast to the comparatively high survival on the west side, which next to the south side receives the highest amount of heat and should show only slightly less mortality.

In order to compare the mortality on treated trees both dead and living brood were counted on many trees. The data secured are given in table 8.

Table VIII

MORTALITY OF MOUNTAIN PINE BEETLE IN 32 LODGEPOLE PINE TREATED WITH 75% LIGHT, 25% HEAVY STOVE OIL AND 3/4 LB. NAPHTHALENE TO GALLON OF ABOVE OIL. TREATED JUNE 1936- EXAMINED JULY 1936-ASHTON, IDAHO.

| | Basal Sample | | | | | | | | 5' Sample | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Brood on two sides of tree | | | | Number of 1/4 Sq.ft. samples | | Percent of mortality | | Brood on two sides of tree | | | | Number of 1/4 sq.ft. samples | | Percent of mortality | |
| | Dead | | Living | | | | | | Dead | | Living | | | | | |
| | N | E | N | E | N | E | N | E | N | E | N | E | N | E | N | E |
| | 135 | 152 | 16 | 2 | 19 | 20 | 89.4 | 98.7 | 198 | 205 | 5 | 6 | 20 | 20 | 97.5 | 97.1 |
| Data per sq. ft. | 28.4 | 30.4 | 3.4 | .4 | --- | --- | --- | --- | 39.6 | 41.0 | 1.0 | 1.2 | --- | --- | --- | --- |
| Average | 29.4 | | 1.9 | | | | 94.1 | | 40.3 | | 1.1 | | | | 97.3 | |

In the preceding tabulation the data for dead brood include only the large larval, pupal, and new adult stages. Consequently only a small proportion of the total mortality for all stages of development is included. Even on that basis it may be seen that the indicated mortality due to the treatment is very high.

To determine if two sprayings on successive days were more effective than one, five trees were so treated. Although data from five trees can hardly be considered as a large enough number to be representative of that type of treatment, it at least should be indicative of what can be expected. The results of the examinations are given in table 9.

Table IX

FIVE LODGEPOLE PINE SPRAYED ON TWO SUCCESSIVE DAYS WITH FORMULA 75% LIGHT-25% HEAVY STOVE OIL, AND 3/4 LB. NAPHTHALENE

| Data per Square Foot | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Basal Sample | | | | | | | | | | | |
| Brood | | | | Percent dead is of total brood | | | Number of attacks | | (1) Percent emergence is of attacks | | |
| Dead | | Living | | | | | | | | | |
| N | E | N | E | N | E | Aver. | N | E | N | E | Aver. |
| 24.0 | 7.2 | 3.2 | 1.6 | 88.2 | 81.8 | 85.0 | 17.6 | 14.4 | 9.1 | 5.6 | 7.3 |
| 5' Sample | | | | | | | | | | | |
| 34.4 | 8.0 | -- | -- | 100 | 100 | 100 | 15.2 | 10.4 | 0 | 0 | 0 |

(1) On basis of two adults for each attack.

Trees sprayed twice with the above formula on successive days gave slightly better control than trees sprayed but once, on the basis of comparing emerging to attacking insects, and slightly less control on the basis of dead compared with surviving brood, with an average of the two methods showing almost identical results. Therefore, there is no apparent advantage in spraying trees twice.

The data from three trees felled and sprayed showed 100 percent control at five feet, but incomplete although good control at the base. Again the average degree of control practically coincides with that secured in the standing trees. The data are given in table 10.

Table X

THREE MOUNTAIN PINE BEETLE-INFESTED LODGEPOLE PINE FELLED AND SPRAYED WITH 75% LIGHT, 25% HEAVY STOVE OIL AND 3/4 LB. NAPHTHALENE TO EACH GALLON OF ABOVE OIL. SPRAYED 6/26/36; EXAMINED 7/29/36 - ASHTON, IDAHO

| Data per Square Foot | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Basal Sample | | | | | | | | | | | |
| Brood Dead | | Brood Living | | Percent dead is of total brood | | | Number of attacks | | | Percent dead brood is of attacks | | |
| N | E | N | E | N | E | Aver. | N | E | | N | E | Aver. |
| 26.7 | 37.3 | 6.7 | -- | 79.1 | 100 | 90.5 | 16.0 | 20.0 | | 79.1 | -- | 90.7 |
| 5' Sample | | | | | | | | | | | |
| 28.0 | 29.3 | -- | -- | 100 | 100 | 100 | 21.3 | 13.3 | | 100 | 100 | 100 |

From the preceding data we may conclude that in trees infested too high to be reached by spraying from the ground successful control can be secured by spraying after felling.

Treatment of Mountain Pine Beetle-Infested Lodgepole Pine With Formula Totaling 15 gal. Light, and 5 gal. Heavy Stove Oil, 5 gal. Orthene, and 15 lbs. Naphthalene

This treatment gave very good control. A few insects, averaging but 5.6 percent of the larger brood stages at the time of treatment, survived spraying at the base of the trees. At five feet control was complete, and at eight feet survival was only slightly over half the number surviving at the base. In striking contrast is the large number surviving in the unsprayed portion at twelve feet. The data are shown in table 11. In Plate I, figures 3 and 4 are shown--examinations being made at 12 feet. Note improvised safety belt.

Plate I

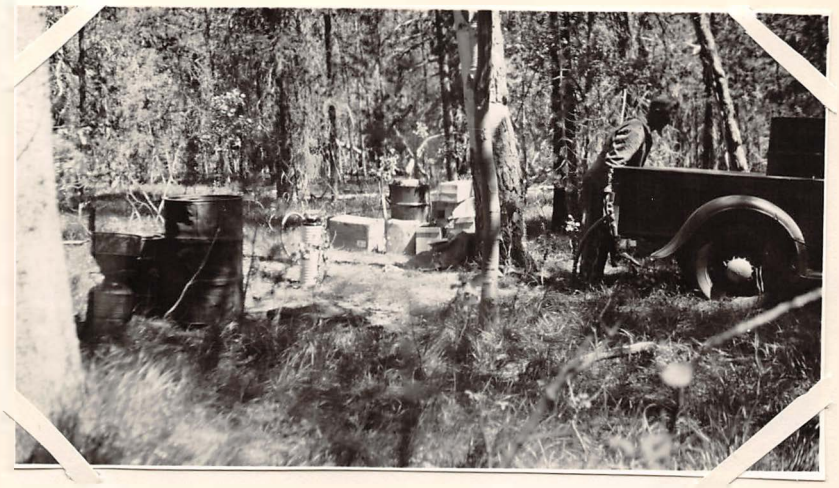

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Table XI

STATUS OF MOUNTAIN PINE BEETLE IN LODGEPOLE PINE SPRAYED WITH 15 GALLONS LIGHT, 5 GALLONS HEAVY STOVE OIL, 5 GALLONS ORTHENE, AND 3/5 POUND OF NAPHTHALENE PER GALLON OF LIQUID. SPRAYED IN JUNE 1936-EXAMINED IN JULY 1936 - ASHTON, IDAHO

| Section | Brood Survival per Square Foot At | | | | | | | | Percent dead are of total brood | | | | Percent surviving insects are of number attacking at (1) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Base | | 5' | | 8' | | 12' | | Base | | 5' | | Base | | 5' | | 8' | | 12' | |
| Side | N | E | N | E | N | E | N | E | N | E | N | E | N | E | N | E | N | E | N | E |
| 24 treated trees | 1.0 | .8 | -- | -- | .67 | .33 | 19.7 | 10.7 | 95.3 | 92.4 | 100 | 100 | 2.5 | 2.9 | -- | -- | 2.9 | 1.4 | 84.3 | 59.3 |
| 17 untreated trees | 27.8 | 15.8 | 17.7 | 10.6 | 19.5 | 2.8 | 12.2 | 1.2 | -- | -- | -- | -- | 67.8 | 44.1 | 57.1 | 44.2 | 80.0 | 10.8 | 63.4 | 6.8 |

(1) On basis of two insects making each attack.

At the base and at five feet above the ground treated and untreated trees are almost identical in average diameter. At eight and twelve feet data are available from only one-half the treated trees, and these average about one-half inch larger in diameter at twelve feet than the untreated trees. This larger diameter which has been found to be associated with more numerous brood is believed to largely account for the much higher brood present in the treated trees at twelve feet.

To determine if sprayings at different times during the day might influence the effectiveness of the treatment, records were kept of when the trees were sprayed. Survival, however, was so little and confined to so few trees that any correlation was impossible.

Treatment with Light Stove Oil 20 gal. and Orthene 5 gal. to Control the Mountain pine Beetle in Lodgepole Pine. Sprayed in June 1936--Examined in July 1936, Ashton, Idaho

Twenty-three trees were sprayed with this formula.

Control with this formula was excellent. Survival was highest at the base on the north side of the tree, where the living brood was 7.3 percent of the total of dead and living, or 3.9 percent of the number that attacked. The east side showed less than one percent of survival regardless of whether compared on the basis of emergence versus attacks or living versus dead brood.

At five feet above the ground the control was better than 98 percent.

At eight feet only one lightly sprayed side of one tree showed any survival. Excluding that sample, the control secured was complete.

A resume of the data is shown in table 12.

Table XII

COMPARISON OF BROOD STATUS OF THE MOUNTAIN PINE BEETLE IN LODGEPOLE PINE TREATED WITH 20 GAL. OF LIGHT STOVE OIL (THERMALENE 32-34 SP.GR.) AND 5 GAL. OF ORTHENE TREATED IN JUNE 1936--EXAMINED IN JULY 1936
ASHTON, IDAHO

| | Data for Basal Section | | | Data for 5' Section | | | Data for 8' Section | | | Data for 12' Section | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Attacks per sq.ft. | Emergence per sq.ft. | % Emergence is of attacks (1) | Attacks per sq. ft. | Emergence per sq.ft. | % Emergence is of attacks (1) | Attacks per sq. ft. | Emergence per sq.ft. | % Emergence is of attacks (1) | Attacks per sq. ft. | Emergence per sq.ft. | % Emergence is of attacks (1) |
| Data from 23 treated trees | 15.0 | .7 | 2.3 | 12.6 | .26 | 1.0 | 10.2 | 1.4 (2) | 8.2 | 11.0 | 17.3 | 78.6 |
| Data from 17 untreated trees | 17.6 | 21.0 | 59.7 | 12.5 | 10.9 | 43.4 | 11.4 | 9.5 | 41.7 | 8.5 | 5.8 | 33.8 |

(1) Based on two insects being required for each attack.

(2) All from one lightly sprayed area on one tree.

The preceding table indicates quite clearly the excellent control secured with this formula.

In order to more readily compare results secured with the three formulae used in 1936, the following table consolidating all the data has been prepared.

Table XIII

COMPARISON OF CONTROL SECURED BY TREATMENTS WITH THREE DIFFERENT FORMULAE OF LETHAL OILS--TREATED IN JUNE 1936--EXAMINED IN JULY 1936 - ASHTON, IDAHO

| Stove oil and chemical formula | Data for Basal Section: Attacks per sq. ft. | Emergence per sq.ft. | % Emergence is of attacks | Data for 5' Section: Attacks per sq. ft. | Emergence per sq.ft. | % Emergence is of attacks | Data for 8' Section: Attacks per sq. ft. | Emergence per sq.ft. | % Emergence is of attacks | Data for 12' Section: Attacks per sq. ft. | Emergence per sq.ft. | % Emergence is of attacks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 75% Light, 25% heavy, 3/4 lb. Naph. per gallon | 18.1 | 2.85 | 7.9 | 16.2 | .90 | 2.8 | 16.1 | 1.30 | 4.0 | 14.5 | 26.3 | 90.5 |
| 60% Light, 20% heavy, 20% Orthene: 3/5 lb. Naphthalene per gallon | 16.3 | .92 | 2.7 | 12.3 | -- | -- | 11.8 | .50 | 2.1 | 10.3 | 15.7 | 73.4 |
| 80% Light 20% Orthene: | 15.0 | .7 | 2.3 | 12.6 | .26 | 1.0 | 10.2 | 1.4 | 8.2 | 11.0 | 17.3 | 78.6 |
| Untreated trees | 17.6 | 21.0 | 59.7 | 12.5 | 10.9 | 43.4 | 11.4 | 9.5 | 41.7 | 8.5 | 5.8 | 33.8 |

Inspection of the preceding table shows the best control was secured by using the second formula, with the third little less effective, and the first least effective. Between the second and the third formulae there is little to choose in effectiveness.

In order to show the trend of the individual tree data and to furnish another comparison of the three methods of treatment, table 14 is presented.

Table XIV

FREQUENCY OF BROOD IN MOUNTAIN PINE BEETLE-INFESTED LODGEPOLE PINE TREATED WITH LETHAL OILS-TARGHEE ASHTON, IDAHO - 1936

Data from North and East Sides of Trees

| Total living brood | Formulae: 40.5 gal. light stove oil; 13.5 gal. heavy stove oil; 40.5 lbs. Naphthalene — Number of trees showing living brood at: Base | 5' | 8' | Formulae: 20 gal. light stove oil; 5 gal. Orthene — Number of trees showing living brood at: Base | 5' | 8' | Formulae: 15 gal. light stove oil; 5 gal. heavy stove oil; 5 gal. Orthene; 15 lbs. Naphthalene — Number of trees showing living brood at: Base | 5' | 8' |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 15 | 24 | 8 | 17 | 21 | 11 | 21 | 24 | 9 |
| 1 | 8 | 4 | --- | 4 | 1 | --- | 1 | --- | 2 |
| 2 | --- | 1 | 2 | 2 | 1 | --- | --- | --- | --- |
| 3 | 2 | --- | 1 | --- | --- | --- | --- | --- | --- |
| 4 | 4 | 3 | --- | --- | --- | --- | 1 | --- | --- |
| 5 | 1 | --- | --- | --- | --- | --- | --- | --- | --- |
| 6 | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 7 | 1 | --- | --- | --- | --- | --- | --- | --- | --- |
| Trees | 31 | 32 | 11 | 23 | 23 | 11 | 23 | 24 | 11 |

The comparatively narrow spread of the data and the relative effectiveness of the three methods of control can be clearly seen in the preceding table.

Late Spraying in 1936

On July 31st five trees were sprayed with a mixture of 80 percent light stove oil and 20 percent orthene to which had been added 3/4 pound of naphthalene per gallon of oil, and five additional trees with the same liquid mixture but no naphthalene. When examined on September 28th, very uncertain results were noted. Some mortality had occurred, but no high degree of control such as was secured with the early summer treatment. It is possible that examinations made in the spring of 1937 will show very high mortality, but the results to date are not promising. In view of the excellent results this season with early summer treatment, and from fall spraying the year previous, the poor control obtained with treatment in late July is somewhat puzzling. However, the bark may have been too green to have readily absorbed the oil, and treatment later in the season when the bark is drier may yield much better results in spite of the lower maximum temperatures in autumn. High temperatures are believed to be a factor in controlling the effectiveness of lethal oils. Another factor which may have influenced control was the stage of development of the brood. Only eggs and tiny larvae were present in these trees when they were sprayed and these stages may be more resistant to oils. A third factor, degree of moisture in the bark, may be quite important. It seems logical to

believe the wetter bark of recently attacked trees is less able to absorb oil, thus reducing the effectiveness of the treatment.

## Conclusion

From the preceding report it is seen that excellent control was secured with two of the three oils used this past season, and the third method gave good results. Felling before spraying seems to have been of no special advantage, nor was spraying two successive days any more effective than a single spraying. The time of day the spray was applied does not seem to have had any influence on the degree of control. Bark thickness and time of year the trees are sprayed seem to be major factors effecting control, with possibly brood development and bark moisture at the time of treatment as other important factors.

It is hoped that during the coming season the two oils which gave the best control will be given further tests. To the writer it seems quite important that the period during which this method can be used be obtained. By using the lighter viscosity oils early and late in the summer season, when maximum temperatures are considerably below those of midsummer, it may be possible to extend the period during which effective control may be secured.

## Summary

Treatments with lethal oils in October 1935 gave, in the main, excellent control. The most effective of the three oils tried was Standard Oil Formula 21046-R, with Reilly's Penetrating Creosote ranking

second. Evidence of good control was not apparent until emergence of the new brood was imminent. An early examination showed only a little less than normal living brood in the treated trees and no indication of subsequent heavy mortality.

In 1936 spraying with lethal oils was conducted on a much larger basis, using three formulae. The formula comprising 80 percent light, 20 heavy stove oil, 20 percent orthene, and 3/5 pound of naphthalene per gallon of oil gave the best control with the mixture of 80 percent light oil and 20 percent orthene a close second. The mixture of 75 percent light and 25 percent heavy stove oil with 3/4 pound of naphthalene was least effective in control. Apparently orthene is more lethal to the mountain pine beetle than naphthalene, and the combination of the two with the stove oils the most effective.